## ABSTRACT OF THE DISCLOSURE

A system and method for detecting structural damage is provided that utilizes a general order perturbation methodology involving multiple perturbation parameters. The perturbation methodology is used iteratively in conjunction with an optimization method to identify the stiffness parameters of structures using natural frequencies and/or mode shape information. The stiffness parameters are then used to determine the location and extent of damage in a structure. A novel stochastic model is developed to model the random impact series produced manually or to generate a random impact series in a random impact device. The random impact series method or the random impact device can be used to excite a structure and generate vibration information used to obtain the stiffness parameters of the structure. The method or the device can also just be used for modal testing purposes. The random impact device is a high energy, random, and high signal-to-noise ratio system.